227

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CYSTOMETRICAL AND IN-VITRO MUSCLE STUDIES OF ENTEROCYSTOPLASTIC BLADDERS IN THE RAT

Hypothesis / aims of study

In enterocystoplastic procedures, a bowel segment is inserted into the bladder to increase capacity and/or to reduce pressure. Enterocystoplastic muscle from implanted bladders has been shown to exhibit degeneration of myenteric plexa. Sprouting of nerves from the bladder to the anastomosed bowel segment has also been demonstrated [1]. In the present study, the functional integration of enterocystoplasties was investigated in an awake rat cystometry model and in vitro

Study design, materials and methods

73 female Sprague-Dawley rats (200 g.) were used. Under anesthesia, the upper fourth of the bladder was removed, and an appendiceal segment (7 x 7 mm unstretched), with preserved vasculature, was incorporated and secured with continuous sutures to the upper part of the bladder. After 1 or 3 months, a polyethylene (PE)-50 catheter was introduced and fixed to the top of the bladder. After a 3 day recovery, cystometries were performed in awake animals. In separate experiments, agonist and nerve-induced responses were evaluated on isolated muscle strips. Values are given as mean ± SE, statistical difference was assessed by Mann-Whitney U-test or ANOVA (Bonferroni posthoc.) when appropriate.

Results

Cystometry experiments: Cystometries revealed reduced basal pressure (controls 1 month: 9.7 ± 1.6 vs. operated 1 month: 5.3 ± 0.8 cm H_2O, $p<0.05$; controls 3 months: 12.5 ± 1.7 vs. operated 3 months: 5.0 ± 0.3 cm H_2O, $p<0.001$) and lower micturition pressure (controls 1 month: 89.1 ± 8.8 vs. operated 1 month: 39.7 ± 4.4 cm H_2O, $p<0.001$; controls 3 months: 106 ± 10 vs. operated 3 months: 36.3 ± 3.6 cm H_2O, $p<0.0001$) in animals with enterocystoplasty (ECP). Bladder capacity was increased (controls 1 month: 0.68 ± 0.08 vs. operated 1 month: 1.74 ± 0.25 ml, $p<0.01$; controls 3 months: 0.95 ± 0.21 vs. operated 3 months: 1.97 ± 0.19 ml, $p<0.01$), as was also micturition volume (controls 1 month: 0.68 ± 0.08 vs. operated 1 month: 1.28 ± 0.14 ml, $p<0.05$; controls 3 months: 0,86 ± 0.18 vs. operated 3 months: 1.43 ± 0.10 ml, $p<0.05$). Threshold pressure was significantly lower in the 1 month group (controls: 17.7 ± 3.2 vs.operated:11.1 ± 1.1 cm H_2O; $p<0.05$), but not in the 3 month group. Bladder compliance was significantly higher in the operated 1 month group (controls: 0.12 ± 0.02 vs. operated: 0.27 ± 0.06 ml/cm H_2O, $p<0.05$) but not in the 3 month group. Threshold tension was similar in control and corresponding operated groups. Residual urine was significantly higher in the operated groups both at 1 month (0±0 vs. 0.47±0.16 ml, $p<0.05$) and at 3 months (0.09±0.08 vs. 0.54±0.13 ml, $p<0.05$).

In vitro experiments: At 1 month after the sham operation, maximal contractions for detrusor strips amounted to 125 ± 6 % of that elicited by K^+ solution. Preparations from the ECP or control appendix produced lower carbachol contraction amplitudes. Mean maximal contractions to carbachol of 75 ± 11 %, and 46 ± 9 % were obtained for ECP and appendix strips respectively. Both were significantly lower than that of detrusor but there was no significant difference between implant and appendix. After 3 months, maximal relative tension of 121 ± 6 % was reached for the detrusor. Implants from ECP bladders responded with maximal contractions of 66 ± 11 % ($p<0.05$ vs. detrusor and control appendix), preparations from control appendix produced contractions of 24 ± 4 % ($p<0.05$ vs. detrusor and implants). In detrusor preparations from sham operated animals, addition of alpha-beta-MetATP (10^{-5} M) resulted in contractile responses of 29 ± 8 % (1 month) and 35 ± 2 % (3 months). In contrast, implant and control appendix muscle responded at both 1 and 3 months with a slight reduction in tension to alpha-beta-MetATP (10^{-5}M).

Frequency-response curves of electrically induced responses did not differ much between the different groups and times. Scopolamine (10^{-11} -10^{-6} M) attenuated electrically induced responses in preparations of detrusor, implant and control appendix from both 1 and 3 month groups. In the 1 month groups, maximal inhibitory effect was 69 $\pm$ 3 % (detrusor), 71 $\pm$ 4 % (implant), and 34 $\pm$ 10 % (appendix). The latter group differed significantly ($p<0.05$) from the others. Similar patterns were found for the 3 month groups.

Interpretation of results

The study shows that the enterocystoplastic rat bladders have phasic micturitions with micturition volumes comparable to or larger than in control animals , and with similar threshold wall tension. However, the ECP bladders have a significant post void residual urine. The in vitro results show that the pharmacological properties of the ECP muscle have developed away from those of control intestine towards those of normal detrusor.

Concluding message

In rat, enterocystoplasty muscle is partially integrated in detrusor function.

Reference

Sprouting of bladder nerves into cystoplastic cecal segments in the rat. Urol Res 27:476-482